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THE DISTINGUISHING CHARACTERS OF SUGARCANES CULTIVATED AT SABOUR

BY

E. J. WOODHOUSE, M.A.,

Economic Botanist to the Government of Bihar and Orissa

AND

S. K. BASU, M.A. (Cantab)

Assistant Professor, Agricultural College, Sabour

WITH A NOTE ON THE CHEMICAL CHARACTERS

BY

C. SOMERS TAYLOR, B.A.

Agricultural Chemist to the Government of Bihar and Orissa

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I.—Introduction.

Origin of Work.—In the year 1908 it was decided that the sugarcane crop should be studied at Sabour both from the chemical and botanical standpoints. Arrangements were therefore made by Mr. C. Somers Taylor for the collection through the Divisional Agricultural Inspectors of the principal varieties of cane grown in Bengal. Thirty-three varieties (including two pairs of duplicates) were collected and planted on the Sabour farm in February and March 1909. The observations published in this paper were made on selections from these varieties and are not necessarily true of all local varieties with the same name to be found in various parts of the Province.

Method of Selection.—The original samples had been procured from the fields of cultivators and were presumably fair average

samples of the cane grown under that varietal name in the area in question. These were planted in February and March 1909, half the quantity being planted as whole canes and half as cuttings. At the end of the season mass selections of the best canes of each variety were made and the selected canes planted in March 1910. In some cases the canes of a variety were divided into two groups according to the relative size of the nodes and internodes or the colour of the canes, and these were sown in separate plots. No differences however were noted between the canes of the plots derived from these selections. By the beginning of the next season (February 1911) some idea had been obtained of what were the constant distinguishing characters of the cane varieties and it had become clear that some of the varieties did not consist of one uniform type. It was therefore decided to select two single bushes of each variety that appeared to be pure and two single bushes of each of the types that were suspected to be present in some of the other varieties. At the time of making these selections each bush was examined in detail both in the field and laboratory. Since 1911 these pure lines have been grown in pure culture and have provided the material on which all the observations recorded in this paper have been made.

By growing the cane in pure culture we were able to prove by means of the botanical evidence that certain of the varieties[1] were impure and at the same time our observations regarding all the types examined were placed on a firm foundation. Our observations were confirmed by those of Mr. Taylor[2] and the combined

[1] In this connection it may be mentioned that the cane which came from Behta under the name of *Ketari* was found to be a mixture of two components similar to two other types of tall canes, namely, *Bansa* and *Baraukha*, which types have been separated out and called *Ketari No. I* and *Ketari No. II* respectively. Another cane of the same name was received from Kanti in Muzafferpur. This cane agreed neither with *Bansa* nor with *Baraukha* but was similar to *Maneria*, hence this has been called *Ketari No. III*. Similarly the cane which came from Behta under the name of *Chynia* was found to be a mixture of *Baraukha* and *Maneria* types; these types have been separated and are described under *Chynia* No. I and *Chynia* No. II.

[2] This is well illustrated by the case of the fibre content of *Chynia* varieties quoted by Mr. C. S. Taylor in page 3 of his "Notes on Experiments with Sugarcane at Sabour." (*Bulletin No. 39, Agricultural Research Institute, Pusa*), and somewhat similar results were obtained in the case of *Ketari*.

observations show clearly that the value of any accurate work on the chemical or other characters of varieties is likely to be very largely discounted if the varieties have not been derived from *single plant cultures.*

PROGRESS OF WORK.—*In the first two years of the experiment* preliminary field observations were made with a view to finding out what were the distinguishing characters of the cane. In the spring of 1910 the following characters were under examination :—

I.—Field characters.

1. Number of stems on a stool.
2. Average height of canes in field.
3. General appearance of cane, uprightness or otherwise of plant in young or older stages.

II.—Leaf.

4. Appearance, such as straight, upright, bent over, etc.
5. Proportion of withered leaves to green ones.
6. Breadth of leaves at middle.
7. Leaf edge.
8. Length of leaves.
9. Colour of leaves.
10. Colour of leaf sheath.
11. Colour of band at base of leaf.
12. Presence of hairs at leaf base.

III.—Stripped canes.

13. General colour of cane.
14. Thickness of cane at internodes and nodes.
15. Length of internodes.
16. Colour above node.
17. Colour of internodes.
18. Presence of wax and colour of wax.
19. Appearance of buds—eyes well developed or not.
20. Appearance of canal above buds.
21. Have eyes sprouted!

In the following spring (1911) single plants were selected in the field and then taken to the laboratory, where careful measurements were made of the canes and leaves according to the same system as is used at present. These measurements, however, are not strictly comparable owing to the fact that in that year all the canes (whether mature or immature) of the selected stools had perforce to be examined in order to give a maximum of material, whereas since 1913 the observations have been confined to ten canes selected from a batch of 100 average mature canes selected from the whole plot. At the time of harvesting the 1910 crop a series of observations were made on the length, number of internodes and diameter of cane in all the varieties. In December 1911 special attention was paid to the study of the flowering of the cane. *Owing to a misunderstanding single plant selections* were again made from the 1911 crop in 1912, observations on the single plants being made on the same lines as in the previous year. This has somewhat complicated the records and has resulted in our present cultures being derived from single plants selected from single plants, a somewhat unnecessary refinement. In the spring of 1913 the 1912 crop was examined according to the present system and only the best cultures of each variety were reserved for planting. The observations made in 1913 were carefully checked on the mature plants of the 1913 crop in the spring of 1914.[1]

METHOD OF CULTIVATION.—The sugarcane varieties under examination have either been grown on the farm or in the Botanical area. Cane is usually grown here on land which has lain fallow or been under a leguminous crop during the previous rains. In November the land is ploughed and cross-ploughed to a depth of 6″ to 9″ with Rajah ploughs. Cowdung manure is then applied at the rate of 200 maunds per acre and is ploughed in with Rajah ploughs, after which the land is cultivated and laddered some four times or as often as is necessary to mix the manure, keep down weeds and conserve the moisture. In January arrangements are made for irrigation and the land is laid out in alternate trenches and ridges,

[1] *Vide* Appx. II.

each 3′ wide, the trenches being about 6″ below the level of the ridged land. Rape cake is then applied at the rate of 10 maunds per acre to the trenches and is forked into the soil which is then irrigated. After the trenches have dried sufficiently they are dug over with forked *kodalis* and are ready for planting which is usually carried out in February. The canes for planting are examined carefully for red rot as they are being cut into lengths, each length having 3 good buds; they then have their ends dipped in tar and are ready for planting. (When white-ants are likely to be particularly troublesome they are dipped in a decoction of *neem* leaves before tarring). The cuttings are then planted in 2 V-shaped furrows down the 2 outside edges of the trenches, the cuttings being planted from 1′ 6″ to 2′ apart. The furrows are then covered in and irrigation water is supplied as necessary during the hot weather, a bag of crude oil emulsion being placed in the channel to keep down white-ant attacks. When the plants are established the clumps are thinned out from 2′ to 3′ apart. After each irrigation the land is hoed lightly to conserve the moisture. When the monsoon has become established and the land is becoming sodden and waterlogged the canes are ridged up with the earth from the ridges in such a way that the ridges become trenches and the trenches ridges. The land is hoed and weeded some 2 or 3 times and finally dug up before it has had time to dry out at the close of the monsoon. The canes will be ready for harvest in January to March. They are not ratooned.

Pressure of other duties has made it very difficult to find time for this work so that it has been under the charge of a number of officers. During the seasons 1909-10 and 1910-11 the preliminary field observations were carried out by myself and Mr. D. Mukherji (Asst. Professor of Botany), who also made the mass selections for the 1910-11 crop. The single plants for the crop of 1911 were selected by me and examined in the laboratory by myself and Mr. A. C. Ghosh (Asst. Economic Botanist), who selected and examined the plants selected for the 1912 crop. During 1911 a number of field observations were made by myself, but my appointment as Principal of the Sabour Agricultural College in June 1911 has since made it very difficult for me to give more than a limited time to the work. The 1912 crop was very thoroughly examined by Mr. Basu in the spring of 1913, Mr. Basu's results being checked by myself. In 1914 the 1913 crop was checked by Mr. Basu and myself. It is due to the thoroughness with which Mr. Basu carried out his portion of the work and to the grasp which he obtained of the characters of the cane that it has been possible to prepare this paper. E. J. W.

II.—Distinguishing characters of cane varieties.

(*a*) Field Characters.

Habit.—Under this head observations were made on the general appearance of the stools in the field. Cane varieties differ very considerably in habit, all the canes of each stool of some varieties being erect and close packed while other varieties may be ascending or decumbent. Even among the short bushy canes, in which group the varieties are very similar, the varieties *Poraya*, *Paunri* and *Rheora* are slightly more spreading than the rest of the group which are almost erect. In the tall canes the differences of habit are very much more marked, the *Baraukha* type being typically erect, the *Maneria* type more spreading, and varieties of the *Bansa* type are usually lying on the ground with the tops of the canes only erect. In most varieties the first young shoots are upright or slightly spreading but in the case of *Khari* and *Nargori* the young shoots are very markedly spreading and in some cases almost horizontal.

Persistence of dry Leaves and Sheaths.—An examination of the varietal plots from December onwards shows that different varieties of cane retain their lower dried leaves and leaf sheaths to a greater or less extent. In the case of the *Buxaria* group the whole length of each cane is completely covered by the persistent sheaths, in the taller varieties however the sheaths are not persistent to the same extent, and in most of the "thick" foreign varieties the canes are found to be bare of leaves. While these differences may be due to some inherited character of the cane, it is possible that the persistence of the leaves in the *Buxaria* group may be due to the shortness of the cane and the high tillering which prevent the wind from getting at the old dry leaves. In the thick canes the small number of tillers and their slightly spreading habit may enable the wind to detach the leaves more easily. In the taller varieties the elongation of the aerial roots would probably help to detach the sheaths.

TILLERING.—The examination of this character was usually carried out at harvest time, and to obtain comparative figures the total number of mature canes (excluding young shoots) in as many bushes as possible was counted. It will be seen from the table given below that the short bushy canes have a high tillering capacity (9—16) though the thicker members of the group, *Buxaria, Hemja, Paunri* and *Poraya* fall considerably short of the average (13—16) attained by the thinner varieties *Lewari, Rheora,* and *Mango.* The tall canes all tiller to about the same extent and give results about equal to the thicker members of the *Buxaria* group (*viz.*, 9—10). *Nargori* differs from the rest of the tall canes in its higher tillering capacity (13). The thick imported canes give a very low average (5—6). It would appear therefore that the tillering capacity varies inversely with the thickness of the cane.

Table showing the tillering of different varieties of cane.

No.	Variety.	No. of stools.	No. of canes.	Average.	No.	Variety.	No. of stools.	No. of canes.	Average.
	Group 1.					*Group* 6—(contd).			
1	Buxaria ..	110	992	9	19	Lata ..	347	3,817	11
2	Hemja ..	128	1,256	10	20	Khagri ..	36*	433	12
3	Mango ..	325	4,179	13	21	Ketari No. III.	40*	474	12
4	Lewari ..	529	7,952	15	22	Chynia No. II.	14	191	13·5
5	Rheora ..	299	4,951	16·5		*Group* 7.			
6	Paunri ..	254	3,072	12					
7	Poraya ..	254	2,562	10	23	Khelia ..	181	1,388	7·5
	Group 2.					*Group* 8.			
8	Shakarchynia	413	5,680	14	24	Striped Bansa	16	106	7
	Group 3.					*Miscellaneous "thick" canes.*			
9	Bansa ..	264	2,259	8·5					
10	Ketari No. I.	95	759	8	25	Kajla ..	49	281	6
	Group 4.				26	Red Mauritius.	22	110	5
					27	Bombay ..	51	260	5
11	Baraukha	75	760	10	28	Red Bombay.	56	288	5
12	Kewali ..	39	396	10	29	Bhuri ..	31	185	6
13	Nargori ..	238	3,255	13·5	30	Red Java	43	183	4
14	Ketari No II.	66	519	8	31	Red Tanna	2	11	5
15	Chynia No. I.	69	630	9	32	White Mauritius.	18	107	6
	Group 5.				33	Dhalsunder	22	122	5·5
16	Khari ..	180	1,482	8	34	Benarasia-Nepali.	11	68	6
	Group 6.				35	Shamshara ..	23	101	4·5
17	Maneria ..	196	1,931	10	36	Sukli ..	42*	341	8
18	Panshahi ..	252	2,441	10	37	Puri ..	37*	288	8

* Observations of 1911 (crop of 1910) on account of poor crop in 1912. These observations were made by a different observer and are usually rather higher.

(*b*) CHARACTERS OF STRIPPED CANE.

In examining the canes under the following heads immature canes and diseased and dried up canes as well as exceptionally thick canes or unusually thin canes have been neglected. Efforts have always been made to describe what have been considered to be the average canes of a particular variety and for this purpose generally from 150—200 canes of each variety have been cut and 100 average canes have been selected from these for examination, of which ten have been again selected for the detailed measurements. The length and thickness of the various cane varieties vary according to the climatic and other conditions of each year.

GENERAL APPEARANCE OF CANE.—Under this head observations have been made as to whether the canes are straight or curved, and a general idea as to the thickness and length of the cane has been recorded.

LENGTH.—This measurement is taken from the base of the mature cane at the ground level to the base of the green sheath at or about the topmost joint of the cane. It will be seen from the figures in Appendix II, Column 6, that the average of the short bushy canes varied in length from 4′ 6″ to 6′. *Shakarchynia* is about 6′ and the tall canes vary from 7′ to 9′. The thick canes vary from 4′ to 7′, their length being much influenced by the character of the season, cultivation, etc.

NUMBER OF INTERNODES.—The figures for this character were obtained by counting the internodes in the ten typical canes used for obtaining the measurements of length, etc. In the case of the short bushy canes the number of internodes will be about 30 in the case of a cane 5′ long. In the tall canes of the *Bansa* and *Baraukha* types the number of internodes is usually between 30 and 40, while in the case of the *Maneria* and *Khari* types the internodes vary from 26 to 35 and in *Khelia* there are usually not more than 30 internodes.

LENGTH OF INTERNODES.—It was originally expected that it would be possible to obtain figures for this character by dividing

the length of the cane by the number of internodes. It was found, however, that the figures obtained were unsatisfactory on account of the fact that in most canes the internodes at the base and apex are both very short, while the individuality of the cane is shown only in the length of the internodes in the middle of the cane. It was therefore decided to obtain the figures for the lengths of the internodes by finding the middle node of the cane and measuring 5 internodes on each side of it, *i.e.*, 10 internodes in all. and then taking the average of these for the 10 canes examined as the average length of internode for the variety. In the short bushy canes the average length of internode is found to be about 3″ while in *Shakarchynia* it is slightly longer. In the case of the tall canes however there are marked differences, the *Bansa* and *Barankha* types having internodes varying from 3″ to 4″, while in *Maneria* and *Khari* types they usually vary from 4″ to 5″ in length. In the case of *Khelia* also the average length of the internodes varies from 5″ to 6″. It will be seen from the above that in these last three tall varieties the longer internodes make up for their smaller number.

THICKNESS OF CANE.—To determine the thickness and shape of the cane three measurements have been taken of each cane examined. In the first place the diameter of the tenth node from the base was taken, in the second place the diameter of the middle of the internode above the tenth node was taken, and in the third place the diameter of the narrowest part of this internode (usually in the neighbourhood of the "waxband") was measured. In taking all these observations the bud remained uppermost and the measurements were made at right angles to it. In cases where the tenth node was much covered with roots the ninth or eleventh was taken.

The observations given in Appendix II are those made in 1913, and they are generally supported by those of previous years. The thickness of the cane in each strain varies from year to year in accordance with season and cultivation and a certain amount of difference may exist between the thickness of two strains of a variety, which differences would appear in some cases to be

inherited. It would therefore appear that the thickness of the cane is not by itself a useful critical character. It has been found however that in spite of this the varieties of a group usually maintain their relative positions as regards thickness of cane.

SHAPE OF CANE.—In addition to recording the thickness of the cane the above observations were intended chiefly to show clearly the relation of the diameter of the node to that of the internode and the shape of the internode, whether straight, tapering upwards or barrel shaped. As regards the general shape of the cane, in the case of the short bushy canes and also *Shakarchynia* the nodes and internodes are of uniform thickness. Of the tall canes the *Bansa* type has least difference in thickness between the nodes and internodes. In the *Maneria* and *Khari* types the difference in diameter is slightly greater than in *Bansa*, but owing to the greater length of the internodes the difference is not very conspicuous. In the case of *Khari* the internodes taper upwards throughout their length. In the *Baraukha* group the difference in diameter between the nodes and internodes is most prominent. The thick canes are usually over 1″ in diameter, and in the Bombay group have a well marked barrel shape. The varieties appear to vary less in shape than in diameter from year to year.

COLOUR AND MARKINGS OF CANE.—The colour has been expressed in general terms only. At one time an attempt was made to compare all the colours with the standard on the Colour Chart of the French Chrysanthemum Society but the great number of minor variations in colour found in any one variety made it doubtful whether the results would be commensurate with the labour involved. Of the narrower-leaved greenish canes the *Buxaria*, *Shakarchynia* and *Bansa* groups are distinguished by the brighter yellow colour of their canes. The *Baraukha* group on the other hand have canes of a dirty yellow green colour, *Nargori* being slightly brighter than the other varieties. The *Maneria* group is intermediate between the two groups mentioned above. *Khari* is similar to the *Maneria* group except that some of the internodes may have a reddish tint in places. In the case of all these green varieties the immature

canes when exposed to the sun usually develop a reddish colour. The striped canes are represented only by striped *Bansa*. Of the larger-leaved "thick" canes the colour of the cane is greenish in the case of White Mauritius, *Dhalsunder*, *Benaresia-Nepali*, *Shamshara*, *Sukli* and *Puri*; that of Red Java and Red Tanna is greenish yellow with a reddish tinge, *Khelia* is yellowish red to reddish, Bombay, Red Bombay, and *Bhuri* are red to chocolate, while Red Mauritius and *Kajla* are red to purple. *Bansa* and *Ketari* No. I are distinguished from other varieties by the fact that the mature canes are marked with fine brown lines running down the nodes or internodes (*vide* Plate II).

Development of Aerial Roots.—There are marked differences between cane varieties as regards the development of aerial roots, some varieties produce practically none, others develop roots up to about 6 nodes with occasional scattered roots higher up and others again produce roots up to two-thirds or even three-fourths of their length. The short bushy canes are practically devoid of aerial roots. In *Shakarchynia* they are developed up to about 6 nodes and scattered nodes higher up the cane very occasionally produce roots. Of the tall canes the *Bansa* and *Maneria* groups develop aerial roots usually up to 6 nodes, while in the *Baraukha* and *Khari* groups aerial roots are developed up to two-thirds or three-fourths of the length of the cane. In *Maneria* the nodes have prominent tubercles when the roots are not developed. In the thick broader-leaved canes aerial roots are only developed at the lowest six nodes in *Khelia*, while in *Kajla*, White and Red Mauritius, the Bombay group, Red Java and Red Tanna the roots are usually confined to three or four nodes only. In *Dhalsunder*, *Benaresia-Nepali* and *Shamshara* the roots are usually confined to the lowest three or four nodes, but scattered roots may also be found higher up. In *Sukli* and *Puri* aerial roots are generally developed right up the cane.

Wax.—The presence of wax is well marked all over the internodes of the short bushy canes with the result that their colour is altered from yellow or green to honey yellow and sea green. In

the other narrow leaved varieties wax is usually present in quantity in the wax band and elsewhere to a less extent. In the tall varieties the wax is often blackened, this being due apparently to its oxidization as no traces of fungi have been found. In the broader leaved "thick" varieties wax is present to a larger extent in *Kajla* and the Bombay group.

Colour Band.—This term has been applied to the portion of the cane immediately above the nodes (*vide* Plate I), which in some varieties can be distinguished by its deeper colour. The colour band is well shown in the coloured plate of *Maneria* and *Bansa* (Plate II). In the short bushy canes no colour band is distinguishable, in *Shakarchynia* only a very narrow band is present; of the tall canes, the colour band is indistinct in the *Baraukha* type, narrow in *Bansa*, medium in *Maneria* and broad in *Khari*. In the case of *Khari* the band is always very broad and deep brown. In striped *Bansa* the band is present. Of the "thick" broad leaved canes the band is present in *Kajla*, *Khelia* and Red Java, not well marked in *Shamshara* and inconspicuous in the Bombay type and Red Mauritius.

Buds.—The shape and size of the buds have only been referred to in a very general way. The amount of sprouting varies considerably in different varieties and is probably due to the extent to which the white borer attacks that particular variety (*vide* Section on diseases below.)

(*c*) Leaf Characters.

General Appearance.—In some varieties, notably the short bushy canes and the *Bansa* group, the leaves remain straight with a slight bend at the tip; while others, such as the thick canes and the *Baraukha* and *Maneria* group have their leaves bent over at about the middle. The leaves of *Shakarchynia* are straight to the tip. In the short bushy canes and the thick canes the young sheaths are shorter and so the ligular band of the younger leaves are lower than those of the older leaves and are therefore hidden between the older leaf sheaths, whereas in the *Maneria* and *Baraukha* group the sheaths of the younger leaves are equally developed and

ligular bands emerge from between the lower leaf sheaths, except in the case of the 3 or 4 youngest leaves at the very top of the cane.[1] *Shakarchynia* is intermediate between these groups with the result that a large number of leaves spread outwards from one point in a fan-like manner.

SIZE.—The observations of these characters were taken at harvest time on the leaves to be found in the crown of the cane. They refer to the largest leaves to be found at that time, at which it was difficult to obtain green unbroken leaves. The leaves attain their largest size in the thick canes, the largest leaf being 5′ by 2·5″ in Java and Tanna. The smallest leaves are found in *Shakarchynia* (2′ 6″ by 1″). In the tall canes they are of medium size (3′ 0″ to 3′ 6″ by 1″ to 1·5″), and differ from those of the short bushy canes only in their breadth.

COLOUR.—When looking at the plots of the cane varieties at a distance it is usually possible to observe some difference between the colour of the foliage of the different groups. The thick varieties have a markedly lighter or yellower colour than the others, the short bushy varieties being slightly lighter in colour than the tall canes. Of the tall canes the *Maneria* group has somewhat lighter coloured leaves than the *Baraukha* group.

LIGULAR BAND.—This term has been applied to two patches of colour which appear at the junction of the leaf blade and sheath on the outer side of the leaf over the ligule (*vide* Plate I).

This band varies from yellowish green to deep red or brown. In the case of the short bushy canes it is lighter than the surrounding region. In *Shakarchynia* it is dirty yellow brown. In the tall canes it varies from pale yellow in the *Baraukha* group, through faintly reddish yellow in *Bansa*, brownish yellow in *Khari*, to reddish in *Maneria*. Among the thick canes also the ligular band varies from yellow in *Shamshara* and *Benaresia-Nepali* to brownish in the Bombay group and Mauritius. During some chemical selection experiments carried out by Mr. Taylor in 1910 we were able to trace

[1] *Vide* Plate III.

some correlation between the colour of the juice and that of the ligular band in *Khari* and *Maneria* but it has not been possible to follow up this observation.

(*d*) OTHER CHARACTERS.

WEIGHT OF 100 CANES.—In order to ensure that average canes were used for weighing, 100 average canes were selected from the 150 to 200 canes harvested for examination. In some varieties the canes were found to differ markedly in thickness and in these canes the proportion of thick to thin canes in the bulk sample was determined and the 100 canes required for weighing were selected according to these proportions. It was not possible to obtain 100 canes of the thick varieties so that 10 average canes only were measured and the results multiplied up. In all cases the canes were stripped and the crowns cut off to within a few inches of the top of the cane.

FLOWERING OF CANE.—It would appear that cane only flowers at Sabour in exceptional years. The list below shows the varieties that have been observed in flower at Sabour, together with the year in which the observation was made—

Chynia No. 1	1911.
Khari	1909, 1910, 1911, 1912.
Khelia	1911.
Maneria	1911.
Panshahi	1911.
Shakarchynia	1911.

It will be seen that *Khari* usually produces some flowers, but did not do so at all in December 1913. The year 1911 was a particularly favourable year for flowering. *Khelia* was the only variety in which the anthers dehisced, so that it may be useful for breeding purposes in this part of India. In the case of *Chynia* the flowers hardly emerged from the leaf sheath.

DISEASES.—The two principal fungus diseases are smut and red rot. Smut is usually only found in the *Khari* variety. Red

rot attacks all the tall canes but is less prevalent in the *Bansa* group and *Khari* than in the *Baraukha* and *Maneria* groups. The short bushy canes are more or less immune to red rot. Of the thick canes the Bombay group are usually attacked by red rot.

The chief insect pests are the two borers[1] and of these the moth borer is responsible for the bulk of the damage. Some observations were made in March 1914 on the damage done by white borer and in the crop examined it was found that the thick canes were usually very little attacked (0—40 per cent.), the tall canes usually attacked to an extent of about 40—60 per cent. and the short bushy canes to a very variable extent (4—70 per cent.). While no definite conclusions can be arrived at as the result of these observations, it is of interest to note that in many cases the badly attacked and immune varieties were next each other, so that it would seem that immunity to attack by borers may be a varietal characteristic.

Chemical Characters (contributed by C. Somers Taylor).

It will be of interest to note how far the chemical properties of a cane are connected with its botanical characters and to see whether the canes may be grouped chemically and whether these groups agree with the botanical ones.

In 1910 some measurements were made which led to the conclusion that the periods of maturity differed very greatly among the different canes grown at Sabour. The only canes that grew well at Sabour were the dwarf canes and the tall reed-like canes. Of these it was found that while there was practically no change in the saccharose content of the juice of *Khari* and *Shakarchynia*, the dwarf canes (with the exception of *Lewari* which was stunted) showed a large increase even up to March.

The canes known as *Maneria* and *Panshahi* showed a definite cessation of ripening in between these two dates. The thick canes

[1] Moth borer = *Chilo simplex.*
White borer = *Scirpophaga auriflua.*

with the exception of *Dhalsunder* cannot be considered ever to have grown sufficiently well at Sabour for reliance to be placed on saccharose determinations, the results of which depend so largely on the growth of the cane as a factor. It is probable, however, that they ripen at a time intermediate between that of *Khari* and the dwarf canes. Incidentally it may be remarked here that during the period under review (1910-1913) there would appear to be least loss on all the canes grown at Sabour by cutting in February and early March, while *Khari* and *Shakarchynia* could be cut in January without serious loss. The dwarf canes when properly grown should never be cut before February. When badly grown they frequently ripen earlier.

At first sight, therefore, *Khari* and *Shakarchynia* would appear to stand in a class by themselves as early ripeners while *Maneria* and *Panshahi* would be typical of another class and the dwarf canes of a final late ripening class. Further observations showed, however, that these canes differed in other ways that could be chemically measured. It was found in 1910 that with the same mill, different varieties gave a far different extraction, *i.e.*, some varieties showed more spongy megass than others. These observations were confirmed in 1912-13 and the results were published in *Pusa Bulletin* No. 37 of 1913.

Taking the two early ripening canes which were provisionally put into the same group we obtain the following figures :—

Cane.	Average fibre on cane.	Average fibre on megass.	Calculated extraction factor 1913.
Khari	16·41	46·3	79·6
Shakarchynia	13·94	42·1	80·1

From these figures we see that *Khari* is a much more fibrous cane than *Shakarchynia* and that it has much the same extraction factor.

Comparing these results with those of *Panshahi* and *Maneria* we obtain the following figures :—

Cane.	Average fibre on cane.	Average fibre on megass.	Calculated extraction factor, 1913.
Panshahi	12·71	41·9	82·2
Maneria	12·26	41·3	82·4

Again comparing the results obtained from the dwarf canes we find :—

Cane.	Average fibre on cane.	Average fibre on megass.	Calculated extraction factor.
Buxaria	11·42	34·2	77·5
Poraya	11·74	32·6	74·8
Paunri	12·95	33·5	72·5
Rheora	12·97	33·6	72·6
Hemja	13·03	34·1	73·3
Mango	13·16	34·2	72·9

It will be seen that a characteristic of this group is a medium content of a highly absorbent fibre which, except in the case of *Buxaria*, gave extraction factors below 75 per cent.

In spite however of the fact that the cane known as *Buxaria* showed a higher extraction factor than the rest it has been included in the group as all its other characteristics are the same.

The canes known as *Khagri* and *Chynia II* are doubtful as regards their place in a chemical classification. They have never ripened well at Sabour and it is difficult to say much about them at present. Their fibre content is similar to those of *Panshahi* and *Maneria* with which they have been grouped botanically, but their extraction appeared to be lower.

There is no doubt however that four definite groups can be obtained from chemical considerations that coincide with four of the groups into which the canes have been classed botanically.

These groups are as follows :—

1. Late ripening, medium fibre, low extraction factor. This corresponds with Botanical group No. 1[1].

[1] The classification of the canes into groups will be found in Section IV, pp. 146-50.

2. Early ripening, medium fibre, high extraction factor, corresponding with Botanical group No. 2.

3. Early ripening, high fibre, high extraction factor, corresponding with Botanical group No. 5.

4. Medium early ripening, medium fibre, high extraction factor, corresponding with Botanical group No. 6.

The ripening of this last group can definitely be measured only in the case of *Maneria* and *Panshahi*, as *Lata* and *Khagri* did not grow well when the measurements were made, and *Ketari* and *Chynia* were not then separated into different groups.

The measurements of the periods of maturity were not made with pure lines. It is hoped that with the greater facilities that should be afforded by a properly equipped sugar station further observations may be made on the pure lines bred by the Economic Botanist.

We may conclude therefore that the chemical and botanical characters of the varieties are closely allied. There is no doubt that the most constant of the former is connected with the quality of its fibre. Observations from year to year show very little difference in the order of extraction of each cane, which is probably a definite characteristic of the cane itself depending on some botanical character.

A table is appended which shows tentatively the grouping of the canes both chemically and botanically.

Group.	Ripens.	Extraction factor in 1913.	Fibre on cane in 1913.
I	Late	74·0± ·5 Low	12·46±·21 Medium
II	Early	80·1±1·4 High	13·04±·59 Medium
III	Doubtful	77·7±1·0 Medium	14·64±·42 High
IV	Probably early	76·8± ·6 Medium	15·68±·27 High
V	Early	79·6±1·4 High	16·41±·59 High
VI	Medium (between II & I)	79·3±1·6 High	12·27±·27 Medium
VII	Doubtful	84·8±1·4 High	13·10±·59 Medium
VIII	Never gives sweet juice under Sabour conditions.	77·5±1·4 Medium	12·74±·59 Medium
Miscellaneous.	Probably medium but these canes do not grow well under Sabour conditions.	*High, varies from* 79·4 to 89·1, all but one above 80.	The fibre of these canes varies from 8·59% in the case of Red-Bombay to 15·36 in the case of Red-Tanna so that an average does not give much information.

CONCLUDING REMARKS.—It will be sufficiently clear from the above account of the characters of the cane that attention has not been paid so much to minute botanical characters as to agricultural characters likely to be of use for identifying canes in the field, or which are likely to determine the value of the cane to the agriculturist. The smallness of the area at our disposal here has made it impossible to grow the canes on a field scale but the work will be continued by a study of the yield, quality of gur and chemical characters of the cane at Sipaya. The inheritance of thickness in a number of pure cultures of one variety may repay study as may the histological differences of the varieties.

III.—Description of cane varieties cultivated at Sabour.

1. Buxaria.—*Clumps* short bushy, canes slightly spreading, completely covered with persistent dry leaves and sheaths; *Tillering* 9 on an average, maximum observed 23. *Canes* typically straight, short and fairly thick, length 4′ to 6′, number of internodes varies according to the length of the canes, a cane 5 ft. long has approximately 30 internodes, length of internodes in the middle of the cane 3″ on an average. *Thickness* more or less uniform in the node, internode and top of the internode which varies from 0·8″ to 1″ in diameter. *Colour* honey yellow to sea green in varying proportion with patches of brown. *Wax* thickly present all over the cane, more thickly on the wax band just below the node. *Rooting band* inconspicuous; *aerial roots* typically absent; *Dormant buds* stout and of equal length and breadth; sprouting rare; *colour band* not well defined. *Leaves* more or less upright, bending at the top, size of blade 3′ 6″ by 1·5″, colour of leaves light green to dark green, *ligular band* slightly lighter in colour than the surrounding region, yellowish green under a deposit of wax. 100 average canes weigh 140 lbs.

This cane is not known to have flowered at Sabour and there is no evidence to show that it has flowered anywhere else in the Province. It is generally found to be free from the attacks of red rot or white borer and is on the whole a good clean cane.

2 Hemja.—*Clumps* short and dense, canes slightly spreading out like Buxaria, completely covered with dry persistent leaves and sheaths. *Tillering* 10, maximum observed 21. *Canes* short and fairly thick but not as straight as *Buxaria*, length 4′ to 6′, number of internodes 30 for a cane 5′ long, length of internodes 3″. *Thickness* more or less uniform in the node, internode and the

top of the internode varying from 0·8″ to 1″. The sheath scars are not usually at right angles to the length of the canes. *Colour* perhaps slightly greener than *Buxaria* with patches of brown as in *Buxaria*. *Wax* thickly present all over the cane to about the same extent as in *Buxaria*. *Rooting band* inconspicuous, *aerial roots* typically absent. *Dormant buds* similar to *Buxaria* and sometimes situated in grooves. Sprouting common from the top of the cane often due to attacks of white borer on the main shoot. *Colour band* not well defined. *Leaves* more or less upright bending at the top though not to the same extent as in *Buxaria*, size of blade 3′ 6″ long by 1″ broad, hence narrower than *Buxaria*, colour of leaves similar to *Buxaria*, *ligular band* yellowish green under a deposit of wax. Weight of 100 canes 139 lbs.

This cane has not flowered at Sabour and it is not known to us that it has flowered elsewhere. It is generally free from the attack of red rot but white borer is frequently found to damage the main shoot. It chiefly differs from *Buxaria* in having narrower leaves, darker colour and sprouting buds.

3. Mango.—*Clumps* short and dense, canes slightly spreading, completely covered with persistent dry leaves and sheaths. *Tillering* 13, maximum observed 26 ; *canes* typically straight, short but rather thinner than Buxaria, *length* 4′ 6″ to 6′, number of internodes 30 in a 5′ cane, length of internodes 3″ in the middle of the cane. *Thickness* more or less uniform throughout the length of the cane 0·7″ to 0·8″ in diameter. *Colour* similar to *Buxaria*, being honey yellow to sea green with patches of brown. *Wax* thickly present all over the cane. *Rooting band* inconspicuous, *aerial roots* typically absent. *Dormant buds* stout, conical and almost of equal length and breadth, sprouting occasional, *colour band* not well defined. *Leaves* more or less upright with a bend at the top, size of blade 3′ 6″ by 1″, hence similar to *Hemja* and narrower than *Buxaria* ; colour of leaves light to dark green, *ligular band* yellowish green. Weight of 100 canes 94 lbs.

This cane has not flowered at Sabour and has not been reported to have flowered anywhere else. It is comparatively free from

the attack of red rot, but is liable to the attack of white borer. It looks like *Buxaria*, but is thinner.

4. LEWARI.—*Clumps* short and dense, canes spreading, completely covered with dry persistent leaves and sheaths. *Tillering* 15, maximum observed 30. *Canes* straight, short and rather thin, as compared with *Buxaria*, length 5′ to 6′, number of internodes about the same as in *Mango;* length of internodes 3″ in the middle of the canes. *Thickness* more or less uniform throughout the length of the cane being 0·6″ to 0·7″; *Colour* similar to *Buxaria* between honey yellow to sea green with patches of brown. *Wax* thickly present all over the cane. *Rooting band* inconspicuous; *aerial roots* typically absent. *Dormant buds* stout and conical and of equal length and breadth, sprouting common from the upper portion of the cane. *Colour band* not well defined. *Leaves* similar to *Mango*, size of blade 3′ 6″ by 1″, colour light green, *ligular band* yellowish green, under a deposit of wax. Weight of 100 canes 70 lbs.

This cane is very similar to *Mango*, from which it is hardly distinguishable, if anything it is thinner. It has not flowered at Sabour and is not reported to have flowered anywhere else. It is generally free from attacks of red rot, but is very liable to the attacks of white borer.

5. RHEORA.—*Clumps* slightly taller than the above, dense, canes slightly spreading, completely covered with dry persistent leaves and sheaths. *Tillering* 16, maximum obtained 34. *Canes* slightly curved, somewhat taller than *Buxaria* but thinner, length 5½′ to 6½′, number of internodes varies from 25 to 30 in average canes, length of internode about 3″ in the middle of the canes. *Thickness* more or less uniform throughout the cane, 0·6″ to 0·8″ diameter. *Colour* similar to *Buxaria* honey yellow to sea green with patches of brown. *Wax* present all over the cane. *Rooting band* inconspicuous; *aerial roots* absent. *Dormant buds* of equal length and breadth, stout, sprouting common from the upper part of the cane. *Colour band* not well defined. *Leaves* similar to *Mango*, size of blade 3′ 6″ by 1″, colour light green, *ligular band* yellowish green, under a deposit of wax. Weight of 100 canes 102 lbs.

This cane appears to be superior to *Mango* and *Lewari* and taller, but thinner than *Buxaria*. It has not flowered at Sabour, and has not been reported to have flowered anywhere else. It is only slightly liable to attacks of red rot, but white borer is found to damage the main shoot frequently.

6. PAUNRI.—*Clumps* similar to *Rheora*, canes slightly spreading, completely covered by dry persistent leaves and sheaths. *Tillering* 12, maximum observed 23; *canes* not as straight as *Buxaria* but slightly curved, length 5′ to 6′, number of internodes about 30 in average canes, length of internodes 3″. *Thickness* more or less uniform throughout, the length of the cane being 0·7″ to 0·9″. *Colour* similar to *Buxaria* honey yellow to sea green with patches of brown. *Wax* present all over the cane. *Rooting band* inconspicuous, *aerial roots* absent; *Dormant buds* similar to the above, sprouting common from the upper half of the cane, *colour band* not well marked. *Leaves* similar to the above, *size of blade* 3′ 6″ by 1″, colour light green, *ligular band* yellowish green under a deposit of wax. Weight of 100 canes 114 lbs.

This cane has not flowered at Sabour and has not been reported to have flowered anywhere in the Province. It is generally free from the attacks of red rot, but is very liable to the attacks of white borer which stimulates the upper buds to sprout. A very similar cane to the above.

7. PORAYA.—*Clumps* tall and spreading, almost laid on the ground, canes completely covered by dry persistent leaves and sheaths. *Tillering* 10, maximum obtained 25; *canes* slightly curved with a bend at the top, length 5½′ to 6½′ or even 7 ft., number of internodes about 30 in a 6′ cane, length of internodes slightly over 3″. *Thickness* more or less uniform throughout the length of the cane, if anything the nodes are slightly thicker, 0·8″ to 1″ in diameter. *Colour* similar to *Buxaria* sea green to honey yellow with patches of brown. *Wax* present all over the cane. *Rooting band* inconspicuous, *aerial roots* absent; *Dormant buds* similar to above, sprouting common from the top of the cane, *colour*

band not well defined. *Leaves* larger than the above, size of blade 3′ 6″ by 1·5″, colour light to dark green, *ligular band* yellowish green. Weight of 100 canes 168 lbs.

This cane has not flowered at Sabour and has not been reported to have flowered anywhere else in the Province. It is more or less free from the attack of red rot, but is somewhat liable to attacks of white borer though not to the same extent as *Hemja*, *Mango*, etc.

8. SHAKARCHYNIA.—*Clumps* tall and spreading, sometimes laid on the ground, canes covered with persistent dry sheaths. *Tillering* 14, maximum observed 30. *Canes* slightly curved, length 6′ to 7′, number of internodes varies generally from 24 to 30, length of internodes 3·3″. *Thickness* more or less uniform throughout the length of the cane if anything slightly thicker at the nodes, diameter 0·6″, *colour* yellow green with removable black incrustations, *wax* present in the wax band, scanty in other parts of the cane. *Rooting band* inconspicuous, *aerial roots* well developed in the lowest 4 to 6 nodes, sometimes extending as high as the middle of the cane, *dormant buds* flat and almost circular, sprouting rarely from the top of the cane. *Colour band* narrow, yellow brown. *Leaves* short and narrow, typically straight and spread out in the form of a fan, size of blade 2′ 6″ by 1″, colour light green. *Ligular band* dirty yellow brown under a deposit of wax. Weight of 100 canes 84 lbs.

This cane flowered at Sabour in 1911, but only a few pollen grains were found. It is only slightly liable to attacks of red rot though white borer is sometimes present. It differs from the foregoing canes in many points which have been discussed in Section IV. Longitudinal cracks sometimes occur in the internodes.

9. BANSA.—*Clumps* tall, spreading, bending over or laid on the ground, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 8, maximum observed 20. *Canes* long, thin and more or less straight; length 7½′ to 9½′, number of internodes 30—40, length of internodes 3″—4″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″ with a difference of about 0·1″ between the nodes and internodes. *Colour* bright yellow to yellow green, with

here and there removable black incrustation. *Wax* spread thinly all over the cane with a thick deposit on the wax band. *Rooting band* inconspicuous, *aerial roots* usually confined to about 6 nodes at the base, occasionally developed in some nodes in the middle of the cane. *Dormant buds* are flat or stout, sprouting from the top of the cane. *Colour band* a distinct yellow brown, colour band present. *Leaves* small and erect with tips bending over. Size of blade about 3' by 1·5", *colour* light green, *ligular band* faintly reddish brown, the red being often on the border. Weight of 100 canes 145 lbs.

This cane differs from the foregoing in many important points which have been described in Section IV. It is not known to flower, and is only slightly liable to red rot, though white borer is often found to attack the main shoot. It has some characteristic streaks, both in the internodes and the nodes (*vide* Plate II).

10. KETARI NO. I.—*Clumps* tall, spreading or bending over or laid on the ground, *canes* indifferently covered by dry persistent leaves and sheaths. *Tillering* 8, maximum observed 19. *Canes* more or less straight, tall and thin. *Length* about 7 feet, number of internodes 28—34, length of internodes 3"—4". *Thickness*, nodes 0·6" to 0·8", internodes 9·5" to 0·7", with a difference of about 0·1" between the nodes and the internodes. *Colour* similar to *Bansa*, bright yellow to yellow green, with removable black incrustation. *Wax* spread thinly all over the cane and more thickly in the wax band. *Rooting band* inconspicuous, *aerial roots* usually confined to the lowest 6 nodes occasionally developed higher up the cane. *Dormant buds* flat or stout, sprouting from the top of the cane. *Colour band* yellow brown and distinct. *Leaves* small and erect with tips bent over, size of blades 2' 6"—3' by 1·3" to 1·5"; colour light green, *ligular band* faintly reddish brown. Weight of 100 canes 102 lbs.

This cane appears very similar to *Bansa* though somewhat poorer. It has also the brown streaks found in the nodes and internodes of *Bansa*. It is not known to flower, and is generally

free from the attacks of red rot, though white borer is commonly found.

11. BARAUKHA.—*Clumps* tall, growing almost upright, dried leaves and sheaths indifferently covering the canes though many internodes are exposed. *Tillering* 10, maximum obtained 20. *Canes* almost straight, tall and thin, length 7′ to 9′, number of internodes variable between 30 and 40, length of internodes 3″—4″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″ and top of internodes slightly less than the middle, hence the internodes appear gradually tapering from the bottom to the top, a difference of over 0·1″ is noticeable between the nodes and the internodes. *Colour* dirty yellow green with black incrustations. *Wax* present but not very clear. *Rooting band* swollen, *aerial roots* very common up to two-thirds of the length of the cane or even more, occasionally suppressed in some nodes. *Dormant buds* placed flatly, sprouting common due to attacks of borer. *Colour band* inconspicuously present. *Leaves* bent over from the middle, size of blade about 3′ by 1·5″, colour dark green with a narrow edge of red in some, *ligular band* yellowish green. Weight of 100 canes 106 lbs.

This cane differs from the *Bansa* type in many important characters which will be found in Section IV. It is said to have flowered at Patna in 1911, but has not been found in flower at Sabour. It is very liable to attacks of red rot and white borer.

12. KEWALI.—*Clumps* tall and almost upright. Cane indifferently covered by persistent dry leaves and sheaths, but exposed in some parts. *Tillering* 9, maximum obtained 17. *Canes* almost straight, tall and thin, length about 8′, number of internodes 30—40, length of internodes 3″—4″. *Thickness*, nodes 0·6 to 0·8″, internodes 0·5″ to 0·7″, with a difference of more than 0·1″ between the nodes and the internodes. *Colour* dirty yellow green with black incrustations. *Wax* present in some places but not very clear. *Rooting band* swollen, *aerial roots* present up to about two-thirds of the length of the canes, occasionally suppressed in some nodes. *Dormant buds* flat, sprouting from the top due to borer.

Colour band brownish, inconspicuous. *Leaves* bent over from the middle, size of blade about 3′ by 1·5″, colour dark green with sometimes a reddish border. *Ligular band* yellowish green. Weight of 100 canes 106 lbs.

This cane hardly differs from *Baraukha*. It has not flowered at Sabour and has not been reported to have flowered anywhere else in the Province. It is as liable to red rot and white borer as *Baraukha*.

13. NARGORI.—*Clumps* tall, almost upright, but at first growing in a slightly spreading manner. Canes indifferently covered by dried leaves and sheaths. *Tillering* 13, maximum obtained 30. *Canes* almost straight, tall and thin, length 7½′ to 8½′, number of internodes 30—40, length of internodes 3″—4″. *Thickness*, nodes 0·6″ to 0·8″, internodes 0·5″ to 0·7″, with a difference of more than 0·1″ between the nodes and the internodes. *Colour* slightly brighter than *Baraukha*, the yellow being more marked, black incrustations present. *Wax* scanty. *Rooting band* swollen, *aerial roots* very common up to two-thirds or more of the length of the cane. *Dormant buds* flat, sprouting from the top. *Colour band* brownish. *Leaves* bent over from the middle, size of blade 3′ by 1·5″, colour dark green, *ligular band* yellowish green. Weight of 100 canes 104 lbs.

This cane looks very similar to *Baraukha*, but somewhat brighter in colour, and has a slightly better tillering capacity. It has not flowered at Sabour and has not been reported to have flowered anywhere else in the Province. It is liable to attacks by red rot and white borer. The young canes grow almost like *Khari* in a spreading manner.

14. KETARI NO. II.—*Clumps* tall, almost upright, canes indifferently covered by persistent dry leaves and sheaths. *Tillering* 8, maximum obtained 20. *Canes* almost straight, tall and thin, length 7′ to 9′, number of internodes 30—40, length of internodes 3″—4″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″, with a difference of more than 0·1″ between the nodes and the inter-

nodes. *Colour* dirty yellow green with black incrustation. *Wax* scanty and not very clear. *Rooting band* swollen, *aerial roots* very common up to two-thirds of the length of the cane. *Dormant buds* flat, sprouting common from the top of the cane. *Colour band* yellow brown. *Leaves* bent over from the middle of the cane, size of blade 3′ by 1·5″, colour dark green, *ligular band* yellowish green. Weight of 100 canes 106 lbs.

This cane is hardly distinguishable from *Baraukha* or *Kewali*. It has not flowered at Sabour or anywhere else that we know of. It is liable to attacks of red rot and white borer.

15. CHYNIA No. I.—*Clumps* tall and almost upright, canes covered with persistent leaves and sheaths. *Tillering* 9, maximum obtained 23. *Canes* almost straight, tall and thin, *length* 7′ to 8′, number of internodes 30—40, length of internodes 3″—4″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″, with a difference of more than 0·1″ *between nodes and internodes*. *Colour* dirty yellow green, with removable black incrustations; *wax* scanty and not very clear. *Rooting band* swollen, *aerial roots* present up to two-thirds of the length of the cane. *Dormant buds* flat, sprouting common from the top. *Colour band* brownish. *Leaves* bent over from the middle, size of blade 3′ by 1·5″, colour dark green, with narrow red border in some canes. *Ligular band* yellowish green. Weight of 100 canes 90 lbs.

This cane is hardly distinguishable from *Baraukha*, *Kewali* and *Ketari No. II*. It is very liable to red rot and white borer. *Chynia* is said to flower in different places and at Sabour; this type flowered in 1911.

16. KHARI.—*Clumps* tall, spreading or bending over, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 8, maximum obtained 18. *Canes* more or less straight, length 7½′ to 8½′, number of internodes 25—35, length of internodes 4″ to 5″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·7″ to 0·8″, and top of internodes 0·6″ to 0·8″, the difference between nodes and

internodes being less than 0·1″. *Colour* yellow green with patches of red, the yellow predominating, removable black incrustation present. *Wax* scanty except at wax band. *Rooting band* narrow, *aerial roots* developed high up the cane to nearly two-thirds or three-quarters of the length of the cane. *Dormant buds* flat and tapering, sprouting from the top. *Colour band* brownish, prominent. *Leaves* straight, bending at the top, size of blade 3′ 6″ by 1·5″; *colour* green, *ligular band* brownish. Weight of 100 canes 123 lbs.

This cane differs from the *Bansa* and *Baraukha* types in many respects which will be found in Section IV. It is the only cane which flowers frequently and is reported to have flowered in many localities. It is also very liable to smut disease and to attacks of white borer, but does not suffer much from red rot. The young canes grow in a peculiarly spreading manner.

17. MANERIA.—*Clumps* tall, spreading or bending over, canes *indifferently covered with dry persistent leaves and sheaths. Tillering* 10, maximum obtained 25. *Canes* slightly curved, length 8′ to 10′, number of internodes 25—35, length of internodes 4″—5″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″, with a difference of about 0·1″ between the nodes and the internodes. *Colour* yellow green with patches of red, black incrustation present. *Wax* scanty. *Rooting band* broad and tubercled, *aerial roots* usually confined to about 6 lowest nodes though occasionally some nodes high up the cane give out aerial roots. *Dormant buds* flat and provided with two wing-like scales, sprouting from the top. *Colour band* present, yellow brown or greenish. *Leaves* bent over, medium, size of blade $3\frac{1}{2}'$ by 1·7″, colour light green. *Ligular band* reddish. Weight of 100 canes 156 lbs.

This cane differs from the *Bansa* and the *Baraukha* types in many important points described in Section IV. It also differs from the *Khari* variety in certain respects. It flowered at Sabour in 1911, but the anthers which contained bright yellow pollen grains were not found to dehisce. It is liable to attacks of red rot and white borer.

18. PANSHAHI.—*Clumps* tall, spreading or bending over, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 10, maximum obtained 26. *Canes* slightly curved, length 8′ to 10′, number of internodes 25 to 35, length of internodes 4″ to 5″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″, with a difference of about 0·1″ between the nodes and the internodes. *Colour* yellow green with patches of red, black incrustations present. *Wax* scanty. *Rooting band* broad and tubercled, *aerial roots* usually confined to the lowest 6 nodes or thereabouts though occasionally roots appear high up the cane. *Dormant buds* flat and circular, provided with two wing-like scales, sprouting from the top. *Colour band* distinct yellow brown or greenish. *Leaves* bent over, medium, size of blade 3′ 6″ by 1·7″, colour light green, *ligular band* reddish. Weight of 100 canes 164 lbs.

This cane is hardly distinguishable from *Maneria*. It flowered at Sabour in 1911, the flowers being similar to those of *Maneria* and *Khari*, the anthers did not open. Like *Maneria* it is very liable to red rot and white borer.

19. LATA.—*Clumps* tall and spreading or bending over, canes indifferently covered with dry persistent leaves and sheaths. *Tillering* 11, maximum obtained 23. *Canes* somewhat curved, length 8′ to 10′, number of internodes 25—35, length of internodes 4″—5″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″, with a difference of about 0·1″ between the nodes and the internodes. *Colour* yellow green with patches of red, black incrustation present. *Wax* scanty. *Rooting band* broad and tubercled, *aerial roots* usually confined to the lowest 6 nodes though occasionally found high up the cane. *Dormant buds* flat and circular, sprouting from the top. *Colour band* present, brownish or greenish. *Leaves* medium, bent over, size of blade 3′ by 1·5″ or more, colour light green, *ligular band* reddish. Weight of 100 canes 144 lbs.

This cane is hardly distinguishable from *Maneria*, but if anything, is more spreading in its habit. It has not been found in flower at Sabour nor has been reported to have flowered anywhere

else in the Province. It is very liable to attacks of red rot and white borer.

20. KHAGRI.—*Clumps* tall and spreading, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 12. *Canes* somewhat curved, length 8′ to 10′, number of internodes 25—35; length of internodes 4″—5″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″, with a difference of about 0·1″ between the nodes and the internodes. *Colour* yellow green with patches of red, black incrustations present. *Wax* scanty. *Rooting band* broad, *aerial roots* usually confined to the lowest 6 nodes, occasionally rooting high. *Dormant buds* flat and circular, sprouting from the top. *Colour band* present, brownish or greenish. *Leaves* medium, bent over, size of blade 3′ by 1·6″, colour light green, *ligular band* reddish. Weight of 100 canes 137 lbs.

This cane is very similar to *Maneria*. It has not flowered at Sabour or anywhere else in the Province that we know of. It is very liable to red rot and white borer.

21. KETARI No. III.—*Clumps* tall and spreading, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 9, maximum obtained 18. *Canes* slightly curved; length 8′-10′, number of internodes 25—35, length of internodes 4″ to 5″. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·6″ to 0·8″, with a difference of about 0·1″ between the nodes and the internodes. *Colour* yellow green with patches of red, black incrustations present. *Wax* scanty. *Rooting band* broad and tubercled, *aerial roots* usually confined to the lowest 6 nodes, but occasionally present at the higher nodes. *Dormant buds* flat, sprouting from the top. *Colour band* present, brownish or greenish. *Leaves* medium, bent over, size of blade 3′ by 1·7″, colour light green, *ligular band* reddish. Weight of 100 canes 144 lbs.

This cane is hardly distinguishable from *Maneria*. It has not flowered at Sabour and has not been reported to have flowered anywhere else in the Province. It is very liable to attacks of red rot and white borer.

22. CHYNIA No. II.—*Clumps* tall and spreading, canes covered indifferently with dry persistent leaves and sheaths. *Tillering* 13·5. *Canes* more or less straight, length 7′—9′, number of internodes 25—35, length of internodes about 4″. *Thickness*, nodes 0·7″ to 0·8″, internodes 0·6″ to 0·7″, with a difference of about 0·1″ between the nodes and the internodes. *Colour* yellow green, with red patches and black incrustations. *Wax* scanty. *Rooting band* broad and tubercled, *aerial roots* usually confined to about 6 lowest nodes, but sometimes rooting high. *Dormant buds* flat. *Colour band* present, brownish or greenish. *Leaves* medium, bent over, size of blade 3′ by 1·7″, colour light green, *ligular band* reddish. Weight of 100 canes not available.

This cane is similar to *Maneria* and is very liable to red rot and white borer. It has not flowered at Sabour.

23. KHELIA.—*Clumps* spreading or laid on the ground, rarely standing up, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 8, maximum observed 16. *Canes* very much curved, length 8′ to 10′, number of internodes 25 to 30, length of internodes 5″ to 6″. *Thickness*, nodes 0·8″ to 1″, internodes 0·6″ to 0·8″, with a difference of more than 0·1″ between the nodes and the internodes. *Colour* varies from red to reddish yellow, where covered by sheaths, black incrustations present here and there. *Wax* present all over the cane but more thickly at wax band. *Rooting band* well marked, broad and tubercled; *aerial roots* usually confined to the lowest 6 nodes. *Dormant buds* longer than broad, flat and tapering, usually situated in sunken groves, sprouting rarely from the top of the cane where laid. *Colour band* yellowish or reddish. *Leaves* medium to broad, bent over at the top, size of blade about 3′ 6″ by 2″, colour light green, *ligular band* brownish with faintly reddish edges. Weight of 100 canes 168 lbs.

This cane is very different from the canes previously described. It flowered at Sabour in 1911, when the anthers dehisced. It is not very liable to red rot or white borer.

24. STRIPED BANSA.—*Clumps* tall and upright, or slightly spreading, canes very indifferently covered by loosely persistent dry leaves and sheaths. *Tillering* 7, maximum observed 10. *Canes* tall and more or less straight, internodes slightly zig-zag, *length* 7′ to 8′, number of internodes 25 to 35, length of internodes $3\frac{1}{2}''$ to $4\frac{1}{2}''$. *Thickness*, nodes 0·7″ to 0·9″, internodes 0·65″ to 0·85″, with a difference of less than 0·1″ between the nodes and the internodes. *Colour* striped yellow and red, black incrustations occasionally present. *Wax* scanty except at the depressed wax band. *Rooting band* narrow and almost inconspicuous; *aerial roots* confined to the lowest 6 nodes. *Dormant buds* variable in shape, generally long and tapering and provided with two wing-like scales, sprouting from the top common. *Colour band* deeper reddish than the surrounding region. *Leaves* medium, straight with a bend at the top, size of blade 3′ by 1·5″, colour light green, *ligular band* brownish. Weight of 100 canes 164 lbs.

This cane differs from the above and all other canes in many important points. It is not very liable to red rot but white borer is frequently found to attack it. It has not flowered at Sabour and is not reported to have flowered anywhere else in the Province.

25. KAJLA.—*Clumps* tall or rather of medium height and spreading, canes loosely covered by dry persistent leaves and sheaths. *Tillering* 6, maximum observed 14. *Canes* slightly curved, length 7′ to 8′, number of internodes 25 to 35, length of internodes 4″ to 5″. *Thickness*, nodes 0·9″ to 1″, internodes 0·9″ to 1″, and top of internode slightly less than the middle, the narrowest part being the wax band which forms a depressed ring. *Colour* varies from light red to deep purple. *Wax* present thinly all over the cane and very thickly in the wax band. *Rooting band* frequently yellow and conspicuous, or red and inconspicuous. *Aerial roots* usually confined to the lowest 3 or 4 nodes. *Dormant buds* well developed and prominent, sprouting rare. *Colour band* deeper than the surrounding region. *Leaves* large and spreading, size of blade about 4′ by 2″, *colour* light green, *ligular band* dark brownish. Weight of 100 canes 226 lbs.

This cane is not very liable to attacks of red rot, but white borer is frequently found to attack it. It has not flowered at Sabour and has not been reported to have flowered anywhere else in the Province. *The shape of the cane indicates that it may be* a degenerated Mauritius cane.

26. RED MAURITIUS.—*Clumps* tall, upright or slightly spreading. Canes exposed in many parts. *Tillering* 5. *Canes* more or less straight, length $7\frac{1}{2}'$ to $8\frac{1}{2}'$, number of internodes 20 to 30, length of internodes 4″ to 5″. *Thickness*, nodes 0·9″ to 1·2″, internodes 0·7″ to 1·2″, top of internodes about the same as the middle or slightly less, the narrowest part being the depressed wax band. *Colour* varies from light red to purple. *Wax* thin coat present all over the canes, thick at the wax band. *Rooting band* narrow and either of the same colour as the cane or yellow where the cane is covered by sheaths. *Aerial roots* usually confined to the lowest 3 or 4 nodes. *Dormant buds* slightly tapering, sprouting rare. *Colour band* almost invisible. *Leaves* large and spreading, size of blade about 4′ by 2″, colour light green, *ligular band* reddish brown. Weight of 100 canes 287 lbs.

This cane is somewhat similar to *Kajla* though distinguishable from it. It has not flowered nor has been reported to have flowered. It is not very liable to red rot, though white borer is occasionally found to attack it.

27. BOMBAY.—*Clumps* tall or of medium height, spreading, canes mostly exposed. *Tillering* 5, maximum obtained 11. *Canes* straight or slightly curved, length 6′ to 7′, number of internodes 25—30, length of internodes 4″ to $4\frac{1}{2}$″. *Thickness*, nodes 1·1″ to 1·3″, internodes 1·1″ to 1·5″, top of internodes 1·1″ to 1·3″, hence the internodes are sometimes barrel shaped. *Colour* light red to chocolate. *Wax* present all over the cane, more thickly below nodes in wax bands. *Rooting band* inconspicuous or yellow where covered by the sheaths. *Aerial roots* usually confined to the lowest 3 or 4 nodes. *Dormant buds* tapering, sprouting almost absent. *Colour band* inconspicuous. *Leaves* large and spreading,

size of blade 4′ 6″ by 2·5″, colour light green, *ligular band* brownish. Weight of 100 canes 348 lbs.

A rather soft and good chewing cane, very liable to red rot, but almost free from the attacks of white borer. It has not flowered at Sabour.

28. RED BOMBAY.—*Clumps* tall or of medium height, spreading, canes mostly exposed. *Tillering* 5, maximum obtained 10. *Canes* straight or slightly curved, length 6′ to 7′, number of internodes 25—30, length of internodes 4″ to 4½″. *Thickness*, nodes 1″ to 1·3″, internodes 1·1″ to 1·5″ and top of internodes about the same as nodes, hence the internodes are sometimes barrel shaped. *Colour* light red to chocolate. *Wax* present all over the cane, more thickly in wax band. *Rooting band* sometimes yellow and conspicuous where covered by the sheath, *aerial roots* usually confined to the lowest 3 or 4 nodes. *Dormant buds* tapering, sprouting rare. *Colour band* inconspicuous. *Leaves* large and spreading, size of blade 4½′ by 2·5″, colour light green, *ligular band* brownish. Weight of 100 canes 287 lbs.

This cane is exactly similar to Bombay, and is probably the same cane, with a different name. It is a soft and good chewing cane, rather liable to attacks of red rot, but free from white borer. It has not flowered at Sabour.

29. BHURI.—*Clumps* tall or of medium height, spreading, canes mostly exposed. *Tillering* 6, maximum obtained 12. *Canes* straight or slightly curved, length 6′ to 7′, number of internodes 20—25, length of internodes 4½″ to 5″. *Thickness*, nodes 1″ to 1·2″, internodes 1″ to 1·3″, top of internodes 1″ to 1·2″, hence the internodes are slightly barrel shaped. *Colour* light red to chocolate. *Wax* present all over the cane, more thickly in wax band. *Rooting band* inconspicuous where exposed, yellow where covered by sheath. *Aerial roots* usually confined to the lowest 3 or 4 nodes. *Dormant buds* tapering, sprouting rare. *Colour band* inconspicuous. *Leaves* large and spreading, size of blade 4′ 6″ by 2·5″, colour light green, *ligular band* brownish. Weight of 100 canes 287 lbs.

This cane is exactly similar to Bombay and Red Bombay, and is probably the same cane with a different name. It is a soft and good chewing cane like the above, but is very liable to attacks of red rot, though comparatively free from the attacks of white borer. It has not flowered at Sabour.

30. RED JAVA.—*Clumps* tall and typically upright, canes mostly exposed. *Tillering* 4, maximum observed 9. *Canes* typically straight, length 7′ to 8′, number of internodes 20—30, length of internodes $4\frac{1}{2}$″ to $5\frac{1}{2}$″. *Thickness*, nodes 1·1″ to 1·5″, internodes 1″ to 1·3″, with little or no difference between nodes and internodes. *Colour* yellow green with a tinge of red, when fully ripe somewhat brownish with longitudinal streaks. *Wax* almost absent in the mature internodes but thickly present in the wax band. *Rooting band* often well marked. *Aerial roots* usually confined to the 3 or 4 lowest nodes. *Dormant buds* very small and hemispherical, sprouting absent. *Colour band* narrow and deeper coloured than the surrounding region. *Leaves* large and spreading, *size of blade* 5′ by 2·5″, colour light green, *ligular band* brownish. Weight of 100 canes 350 lbs.

A thick but very hard cane often becoming pithy in the centre, hence not a good chewing cane. It is not very liable to red rot and is free from the attacks of white borer. It has not flowered at Sabour.

31. RED TANNA.—*Clumps* tall and typically upright, canes mostly exposed. *Tillering* 5. *Canes* typically straight, length 7′ to 8′, number of internodes 20—30, length of internodes $4\frac{1}{2}$″ to $5\frac{1}{2}$″. *Thickness*, nodes 1″ to 1·5″, internodes 1″ to 1·5″, slightly narrower at the top of the internode. *Colour* yellow green with a tinge of red, when fully ripe somewhat brownish with longitudinal streaks. *Wax* almost absent in the internodes, thickly present in the wax band. *Rooting band* often well marked. *Aerial roots* usually confined to the lowest 3 or 4 nodes. *Dormant buds* very small and hemispherical, sprouting absent. *Colour band* narrow and deeper coloured than the surrounding region, *Leaves* large

and spreading, *size of blade* 5′ by 2·5″, colour light green, *ligular band* brownish. Weight of 100 canes 370 lbs.

This cane is exactly similar to Red Java and is probably the same cane with a different name.

32. WHITE MAURITIUS.—*Clumps* tall and upright or slightly spreading, canes mostly exposed. *Tillering* 5, maximum obtained 10. *Canes* straight or slightly curved, length 7′ to 8′, number of internodes 25 to 30, length of internodes 4″ to 5″. *Thickness*, nodes 0·9″ to 1·1″, internodes 0·9″ to 1·1″, with little or no difference between the nodes and the internodes. *Colour* greenish yellow. *Wax*, thin coat present all over the cane, thick deposit at the depressed wax band. *Rooting band* inconspicuous. *Aerial roots* usually confined to the lowest 3 or 4 nodes. *Dormant buds* flat and pointed, provided with two wing-like scales, sprouting rare. *Leaves* large and spreading, size of blade 4′ by 2″, colour light green, *ligular band* brownish. Weight of 100 canes 287 lbs.

This cane has not flowered at Sabour. It is not very liable to attacks of red rot or white borer.

33. DHALSUNDER.—*Clumps* tall and spreading, canes mostly exposed. *Tillering* 6, maximum obtained 11. *Canes* straight or slightly curved, length 7′ to 9′, number of internodes 25 to 35, length of internodes 4″ to 5″. *Thickness*, nodes 0·9″ to 1·5″, internodes 0·9″ to 1·3″, with a slight difference in thickness between the nodes and internodes. *Colour* yellow green with tinge of red, ripe canes brownish. *Wax* almost absent except at the wax band. *Rooting band* inconspicuous. *Aerial roots* usually confined to the lowest 3 or 4 nodes, occasionally higher up. *Dormant buds* long and tapering, situated in grooves, sprouting rare. *Colour band* deeper than the surrounding region. *Leaves* large and spreading, size of blade 4′ by $2\frac{1}{2}$″, colour light green, *ligular band* brownish. Weight of 100 canes 287 lbs.

A good soft chewing cane though occasionally liable to become pithy in the centre. Not very liable to attacks of fungus or insect. It has not flowered at Sabour.

34. BENARESIA-NEPALI.—*Clumps* medium or short, slightly spreading or upright, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 6, maximum obtained 15. *Canes* almost straight or slightly curved, length 5′ to 6′, number of internodes 20 to 25, length of internodes $3\frac{1}{2}$″ to $4\frac{1}{2}$″. *Thickness*, nodes 0·9″ to 1·3″, internodes 0·9″ to 1·3″, with slight difference in thickness between nodes and internodes. *Colour* yellow and green in which the green predominates, sometimes a tinge of red is also present. *Wax* very scanty except at the wax band. *Rooting band* inconspicuous. *Aerial roots* usually confined to the few lowest nodes, occasionally rooting very high. *Dormant buds* tapering, sprouting rare. *Colour band* deeper than the surrounding region. *Leaves* large and spreading, size of blade $4\frac{1}{2}$′ by $2\frac{1}{2}$″, colour light green, *ligular band* yellowish. Weight of 100 canes 246 lbs.

A good chewing cane usually free from red rot and white borer. It has not flowered at Sabour.

35. SHAMSHARA.—*Clumps* short or medium, upright or slightly spreading, canes indifferently covered by dry leaves and sheaths. *Tillering* 5, maximum obtained 7. *Canes* more or less straight, length 5′ to 6′, number of internodes 20—25, length of internodes 3″ to 4″. *Thickness*, nodes 0·9″ to 1·1″, internodes 0·9″ to 1·1″, with little or no difference in thickness between the nodes and internodes. *Colour* yellow and green in which the green predominates, sometimes a tinge of red is also present. *Wax* very scanty except at the wax band. *Rooting band* inconspicuous. *Aerial roots* usually confined to the few lowest nodes, occasionally roots are developed high up the cane. *Dormant buds* tapering, sprouting rare. *Colour band* deeper than the surrounding region but not well defined. *Leaves* large and spreading, size of blade 4′ 6″ by 2·5″, colour light green, *ligular band* yellowish. Weight of 100 canes 205 lbs.

This cane appears very similar to *Benaresia-Nepali* and is probably the same cane with a different name. It does not seem to be doing well at Sabour though it is a famous cane of Bengal. It is a good chewing cane and is generally free from the attacks of red rot or white borer. It has not flowered at Sabour.

36. SUKLI.—The cane has considerably deteriorated since introduced at Sabour and the observations of the last 2 or 3 years are useless and misleading. Hence the observations of 1911 are given below :—*Clumps* tall, straight up or slightly spreading, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 8, maximum obtained 15. *Canes* more or less straight, length 7′ to 8′, number of internodes 25 to 35, length of internodes about 4″. *Thickness*, nodes 0·9″ to 1·1″, internodes 0·9″ to 1·1″, with constriction at the wax band. *Colour* lemon yellow and green. *Wax* scanty except at wax band. *Rooting band* inconspicuous. *Aerial roots* high up the cane. *Dormant buds* small. *Colour band* narrow but indistinct. *Leaves* large and spreading, size of blade 4′ by 2·5″, colour light green, *ligular band* yellowish. Weight of 100 canes 230 lbs.

A very good and soft chewing cane when growing to perfection, but very liable to red rot. It has not flowered at Sabour.

37. PURI.—Like *Sukli* this cane has also much deteriorated since introduced at Sabour and the observations of the last 2 or 3 years are misleading, hence the observations of 1911 are given below. *Clumps* medium and slightly spreading, canes indifferently covered by dry persistent leaves and sheaths. *Tillering* 8, maximum observed 21. *Cane* more or less straight. *Length* 6′ to 7′, number of internodes 25 to 30. Length of internodes about 3″. *Thickness*, nodes 0·9″ to 1·1″, internodes 0·9″ to 1·1″, with a constriction at the wax band. *Colour* green to amber yellow. *Wax* almost absent except at wax band. *Rooting band* inconspicuous. *Aerial roots* high up the cane to nearly two-thirds of the cane. *Dormant buds* tapering. *Colour band* indistinct. *Leaves* large and spreading, size of blade 4′ 6″ by 2″, colour light green, *ligular band* yellowish brown. Weight of 100 canes 165 lbs.

IV.—Classification of varieties.

With the above descriptions of the varieties before us we are now in a position to come to some conclusion regarding their relationships.

A.—Shorter bushy canes.

Group 1.—A study of the first seven varieties *Buxaria*, *Hemja*, *Mango*, *Lewari*, *Rheora*, *Paunri* and *Poraya* shows that they are very similar and may be grouped together as short bushy canes with the following common characters.

Clumps short, erect or slightly spreading, canes completely covered by dry persistent leaves and sheaths. *Tillering* comparatively high, between 10 to 16. *Canes* more or less straight. Length 5′—6′, number of internodes about 30, length of internodes about 3″. *Thickness* varies from 0·6″ to 1″ with no difference between nodes and internodes. *Colour* honey yellow to sea green in varying proportion. *Wax* thickly present all over the cane, more thickly at the wax band. *Rooting band* inconspicuous. *Aerial roots* typically absent. *Dormant buds* stout and conical, sprouting common where attacked by white borer. *Colour band* absent. *Leaves* narrow with a bend at the tip. The arrangement of the leaves at the crown is shown in Fig. 1, Plate III, size of blade 3′ to 3′—6″ by 1″—1·5″; colour light green, *ligular band* yellowish green. Weight of 100 canes varies according to the size and thickness. Not given to flowering nor liable to attacks of red rot.

The canes differ somewhat from each other in these respects, but it cannot be said that they could always be distinguished by these characters even when grown and examined side by side. *Buxaria*, *Hemja* and *Poraya* are slightly thicker and have a lower tillering capacity than the other members of the group, *Paunri* being intermediate. As regards leaf characters *Buxaria* and *Poraya* have broader leaves than the rest. *Poraya* is taller and more

spreading than *Buxaria*. *Lewari* and *Mango* are very similar and are shorter than *Paunri* and *Rheora*, which last cane has the highest tillering capacity of the group.

Group 2.—*Shakarchynia* occupies an intermediate position between the above canes and the canes which follow, namely, *Bansa* and *Ketari No. I*. It agrees with the short bushy canes in the appearance of the clumps, in high tillering, in the appearance, length and thickness of the canes and in the colour of the cane, but it differs from them in many important points. The average internodes are longer than in the above group, being nearly 3·5″, wax is scanty except at the wax band, aerial roots are developed in the lower nodes, and sometimes also in the higher nodes, a distinct though narrow colour band is present, the leaves are typically straight and arranged in a fan-like manner and they are also shorter. It will be presently seen that in the presence of aerial roots and the colour band it agrees with the *Bansa* type though the leaf arrangement is peculiar to itself. It should also be noted that this cane is given to flowering.

B.—Tall canes.

Next to *Shakarchynia* we have a large number of canes which are comparatively tall and may be grouped under *Tall canes*. They include canes numbered 9 to 22. By a comparative examination of these canes it is possible to sub-divide them into four distinct groups, three of which have been represented in Plate II.

Group 3.—The first of these groups includes canes numbered 9 and 10, namely, *Bansa* and *Ketari No. I* with the following characters :—Their bushes are seldom upright, but mostly spreading or laid on the ground, canes usually unevenly covered with dry persistent leaves and sheaths ; tillering lower than the 1st group ; internodes longer than in the first group, being 3″ to 4″, and differing from *Shakarchynia* in having their nodes thicker than the internodes, except for the black incrustations colour bright yellow green as in *Shakarchynia* and wax as thick as in the first group ; rooting band and internodes with peculiar brown streaks. Aerial roots and

colour bands developed but the rooting usually confined to the lowest six nodes; leaves more or less upright and arranged in the manner shown in Plate III, Fig. 1, ligular band faintly reddish yellow, the red being often in the border.

The two canes in this group differed slightly in length and thickness in 1913, but in their other characters they would appear to be of one type.

Group 4.—The next group of tall canes include *Baraukha, Kewali, Nargori, Ketari No. II* and *Chynia No. I* and are distinguished by having their bushes upright or slightly spreading, in exhibiting a well marked difference in thickness between the nodes and the internodes, the thickness of which is often more than 0·1"; except in *Nargori* the colour is usually a dirty yellow green. The aerial roots are developed high up the cane. The colour band is inconspicuous. The leaves are more or less bent over. The arrangement of leaves in the crown is an advanced form of what has been represented in Plate III, Fig. 2. The canes of this group are apparently all of one type except *Nargori*, which differs from the others only in its higher tillering capacity, brighter colour and the spreading habit of its young shoots. The group agrees more or less with the previous group in tillering, in the length and thickness of canes and in the number and length of its internodes.

Group 5.—The variety *Khari* occupies a place intermediate between the *Baraukha* and *Maneria* groups. In fact except in having aerial roots well developed high up the canes it has no other point of agreement with the *Baraukha* type; and although it agrees with the *Maneria* group in certain points it still has characters of its own which separate it from the *Maneria* group. The colour band is broad and prominent and the ligular band is brownish. The cane flowers frequently and is peculiarly liable to attacks of the Smut disease.

Group 6.—The *Maneria* group is represented by *Maneria, Panshahi, Lata, Khagri, Ketari No. III* and *Chynia No. II*. They are more or less similar in appearance and it is difficult to separate

them from one another. The clumps are more spreading than the *Baraukha* group though not as prostrate as the *Bansa* group. In tillering all the tall canes seem to agree more or less. In the length and thickness of the cane the *Maneria* group appears to be superior to the others, only *Khari* approaching it in length. In the number and length of internodes we find that the average number of internodes is 25 to 35 and the average length of internodes is 4″ to 5″ as compared with 30—40 internodes and 3″ to 4″ length of internodes in *Bansa* and *Baraukha* groups. In this respect also *Khari* is similar to the *Maneria* type. The difference in thickness between nodes and internodes in the *Maneria* group is about 0·1″. The rooting band is prominent and tubercled and aerial roots are usually confined to the lowest 6 nodes thus agreeing with the *Bansa* group but differing from the *Baraukha* group and the *Khari* canes. A distinct colour band is present in this group, though not as well marked as in *Khari*. In leaf characters it agrees with the *Baraukha* group but the ligular band is reddish here as distinguished from yellowish in *Baraukha* group. The difference between the individual varieties of this group would appear to be so small as to allow of them being classed as one type.

Distinguishing characters of groups of tall canes.

For the sake of convenience the chief distinguishing characters of the various groups of tall canes are given in the following table :—

Character	*Group* 3 (Bansa.)	*Group* 4 (Baraukha.)	*Group* 5 (Khari.)	*Group* 6 (Maneria.)
Bushes	Bent over or laid on the ground.	Upright or slightly spreading.	Spreading	Spreading.
Length of internodes.	3″ to 4″	3″ to 4″	4″ to 5″	4″ to 5″
Thickness of canes.	Thinner	Thinner	Thicker	Thicker.
Colour of cane.	Light yellow green.	Dirty yellow green.	Reddish yellow green.	Yellow green.
Aerial roots	Rooting low	Rooting high	Rooting high	Rooting low.
Colour band	Narrow	Indistinct	Broad	Medium.
Leaves	More upright	More bent over	More upright	More bent over.
Ligular band	Faintly reddish yellow.	Yellowish	Brownish	Reddish.

Groups 7 *and* 8.—Striped *Bansa* is the only striped cane that has been grown here and *Khelia* is a tall red cane with swollen nodes, this cane is usually badly laid and is distinguished by being the only cane which has produced fertile anthers here.

C.—Miscellaneous thick canes.

The remaining canes are mostly foreign canes each with its own distinguishing characters which will be found in the descriptions. The canes have not grown sufficiently well at Sabour to enable us to be certain of their characters and so we only put forward the following suggestions. All except *Sukli* and *Puri* have large light yellow leaves. The varieties Bombay, Red Bombay and *Bhuri* appear to be the same cane with different names. Similarly Red Java and Red Tanna are also probably the same cane with two different names. *Benaresia-Nepali* and *Shamshara* seem to be closely allied canes and were probably originally the same cane. *Khajla* may be a degenerated form of Red Mauritius, with which it agrees in the barrel-like shape of the cane. It differs, however, from Mauritius in having a more spreading habit, more persistent leaf sheaths, deeper colour and a thicker deposit of wax. *Sukli* and *Puri* have not grown satisfactorily at Sabour and we do not venture to offer any opinion on them.

In the above paragraphs the canes have been classified generally into groups but usually no great stress has been laid on stating whether the varieties of a group are exactly of one type or not. This is due to the fact that the influence of cultivation and season affects many of the characters examined to such an extent as to make it difficult to do this, until all the varieties shall have been studied side by side in various environments.

V.—Conclusions.

The chief interest of this paper lies in the fact that it records the results of the first attempts made in India to propagate sugar-cane by the method of pure line cultures. From the information given in the Introduction it is clear that any attempts to obtain reliable results from experiments on the agricultural, botanical, or chemical characters of cane varieties must prove abortive unless pure cultures are used for the experiments.

When once the local varieties had been established in pure culture and the various types isolated it was possible to undertake accurate work on the study of their distinguishing characters, regarding which very little exact data had previously been collected. The information obtained on the subject of the distinguishing characters of the cane is dealt with in Sections II and III and Appendix II, from which it will be seen that there are a larger number of simple field characters by which cane varieties can be distinguished.

In addition to their obvious use in distinguishing cane varieties it is hoped that the detailed observations made regarding the various varieties will prove useful in studying the behaviour of these canes under different climatic and soil conditions and it will thereby be possible to obtain an idea of the suitability of the various groups of canes for the various cane tracts of India. The results of these observations should also in future provide useful information regarding the subject of deterioration.[1]

[1] It is not unlikely, however, that the degeneration of the *dhaul* cane of the United Provinces to *chanli* and *dhamar* is due rather to the admixture of these inferior types than to deterioration due to any defect in the preparation of the cuttings (*vide* Hadi's *Sugar Industry of United Provinces*, page 6).

It has unfortunately not been hitherto possible to take up the study of the chemical and agricultural characters of the cane on a sufficiently large scale to ensure results owing to the small area available for sugarcane work here. These most important branches of the work must therefore lie fallow for the present, and a complete account of the cane varieties and their products with any recommendations as to the best varieties for cultivation is at present out of the question.

SABOUR,
July 31st, 1914.

APPENDIX I.

Table showing the history of the cane varieties.

1	2	3	4	5	6	7	8	9	10
No.	Name.	Locality whence obtained.	Plot number of crop planted in spring of year :—						Remarks.
			1909.	1910.	1911.	1912.	1913.	1914.	
1	Bangla	..	1, 2						
2	Bansa	Purulia	50	18	51	9A-D	12A	9	
				18	52	9E-F	12B	S	
3	Baraukha	Behta	13, 14	6	45	13A-D	17A	11	
				6	46	13E-I	17B	S	
4	Benarasia-Nepali.	Bankipur	21, 22	25	77	33A-C	35A	34	+S
				25	78	—	—		
5	Bombay	Calcutta	61	22	63	22A-C	27A	27	
				22	64	22D-F	27B	S	
6	Bombay Red.	Satgachia (Burdwan).	80, 81	31	65	23A-B	28A	28	
				31	66	23C-D	28B	S	
7	Bhuri	Mohisadal	72, 73	28	67	24A-B	29A	29	
				28	68	24C-D	29B	S	
8	Buxaria	Behta	7, 8	2	10	1A-B			
				2	11	1C	3A	1	
				2	12				
				4A	13	1D-E	3B	S	
				4A	14				
				4B	15				
				4B	16				
9	Chynia	Behta	4, 5	1	38				
				3	39	21A-B	26A	22	Chynia No. II
				3	40	21C	26B	S	do.
				3	41	21E-F	25A	15	do. No. I
				3	42	21G-H	25B	S	do. do.
10	Dhalsundar.	Kustia	89, 90	34	81	34A-B	36A	33	
					82	34C-D	36B	S	
11	Hemja	Saran	29, 30	10	17	2A-E	4A	2	+S
				10	18	2F-H			
				10	19				
12	Java	Burdwan Farm.			1	26A-B	31A	30	
						26C	31B	S	
13	Ketari	Behta	10, 11	5	43	12A-B	15A	10	Also 20G, H of '12 as 15B of '13 sent to Sepaya: Ketari No. I

Col. 6 :—The crop planted in 1911 is the first crop derived from single selected plants.

Col. 7 :—The plots A, B & C of each variety in 1912 were derived from single selected plants and as they were all derived from the original single selected plants in 1911 it is immaterial as to which plot was used for continuing the strain in 1913.

Col. 9 :—The letter S represents the strain sent to the Sepaya sugarcane station for field tests.

Col. 10 :—+S indicates that this strain was both planted at Sabour and sent to Sepaya.

Table showing the history of the cane varieties.—contd.

1	2	3	4	5	6	7	8	9	10
No.	Name.	Locality whence obtained.	Plot number of crop planted in spring of year :—						Remarks.
			1909.	1910.	1911.	1912.	1913	1914.	
				5	44	12C-I	16A	14	Also 20I-J of '12 as 16B of '13 sent to Sepaya, Ketari No. II. Ketari No. III.
14	Ketari	Kanti (Muzaffarpur).	39	14	36	20A-D	24A	21	
				14	37	20E-F	24B	S	do.
15	Kewali	Behta	16, 17	7	47	14A-D	18A	12	
				7	48	14E-G	18B	S	
16	Khagri	Midnapur.	77, 78	30	62	19A-D	23A-B	20	+S
17	Khajla	Burdwan	92, 93	35	69	25A	30A	25	
			,, ,,	35	70	25B-D	30B	S	
18	Khari	Dumraon	66, 67	26	8	11D-F			
			,, ,,	26	7				
			,, ,,	26	9	11G-H	14B	S	
18	(a) Khari	Burdwan Farm.			2				
					3	11A	14A	16	
					4				
					5				
					6	11B, C			
18	(b) Khari	..	..	..	88				
19	Khelia	Kustia	63, 64	23	53	10A-C	13A	23	
				23	54	10D-F	13B	S	
20	Lata	Kustia	58, 59	21	59	18A-D	22A	19	
				21	60	18E-H	22B	S	
21	Lewari	Palmergunj.	55, 56	19	26	4A-L	7A	4	
				19	27	4M-P	7B	S	
22	Maneria	Fatua (Patna)	32, 33	11	55	16A-D	20A	17	
				11	56	16E-H	20B	S	
23	Mango	Fatua (Patna.)	35	12	20	3A, B	—	—	
				12	21	3C-D	5	3	+S
				12	22				

Col. 6 :—The crop planted in 1911 is the first crop derived from single selected plants.

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Table showing the history of the cane varieties.—contd.

1	2	3	4	5	6	7	8	9	10
No.	Name.	Locality whence obtained.	Plot number of crop planted in spring of year :—						Remarks.
			1909.	1910.	1911.	1912.	1913.	1914.	
23	(a) Mango	Ranchi	75	29	24	3E-I	6		
				29	25	3J-L			
24	Mauritius, Red.	Sathi			86	27A-C	32	26	+S
25	Mauritius, White.	Sathi			85	30A-E	34	32	+S
26	Nargori	Kanti (Muzaffarpur).	41, 42	15	49	15A-C	19A	13	
				15	50	15D-F	19B	8	
27	Pandi	Satgachia (Burdwan).	83, 84	32	73	38A-B			
				32	74	38C-D	..		
28	Paushahi	Saran	26, 27	9	57	17A-D	21A	18	
				9	58	17E-H	21B	8	
29	Paunda	Bankipur	19, 20	24					
30	Paunri	South Bhagalpur.	44, 45	16	30	6A-E	9A	6	
				16	31	6F-H	9B	8	
31	Poraya	Dumraon	47, 48	17	32	7A-E	10A	7	
				17	33	7F-G	10B	8	
32	Puri	Oaryia (Burdwan).	86, 87	33	71	37A-B	39A	37	
				33	72	37C-D	39B	8	
33	Rheora	Saran	23, 24	8	28	5A-C	8A	5	
				8	29	5A-G	8B	8	
34	Shakarchynia.	Fatua (Patna).	37	13	34	8A-D	11A	8	
				13	35	8E-H	11B	8	
35	Shamshara	Calcutta	52, 53	20	79	35A-B	37A	35	
				20	80	35C-E	37B	8	
36	Striped Bansa.	..	..	..	83	29A-B	33A	24	
					84	29C-D	33B	8	
37	Sukli	Burdwan	69, 70	27	75	36A-B	38A	36	
				27	76	36C-D	38B	8	
38	Tanna	Sathi	..	..	87	28A-D	40	31	+S

Col. 6 :—The crop planted in 1911 is the first crop derived from single selected plants.

Col. 7 :—The plots A, B & C of each variety in 1912 were derived from single selected plants and as they were all derived from the original single selected plants in 1911 it is immaterial as to which plot was used for continuing the strain in 1913.

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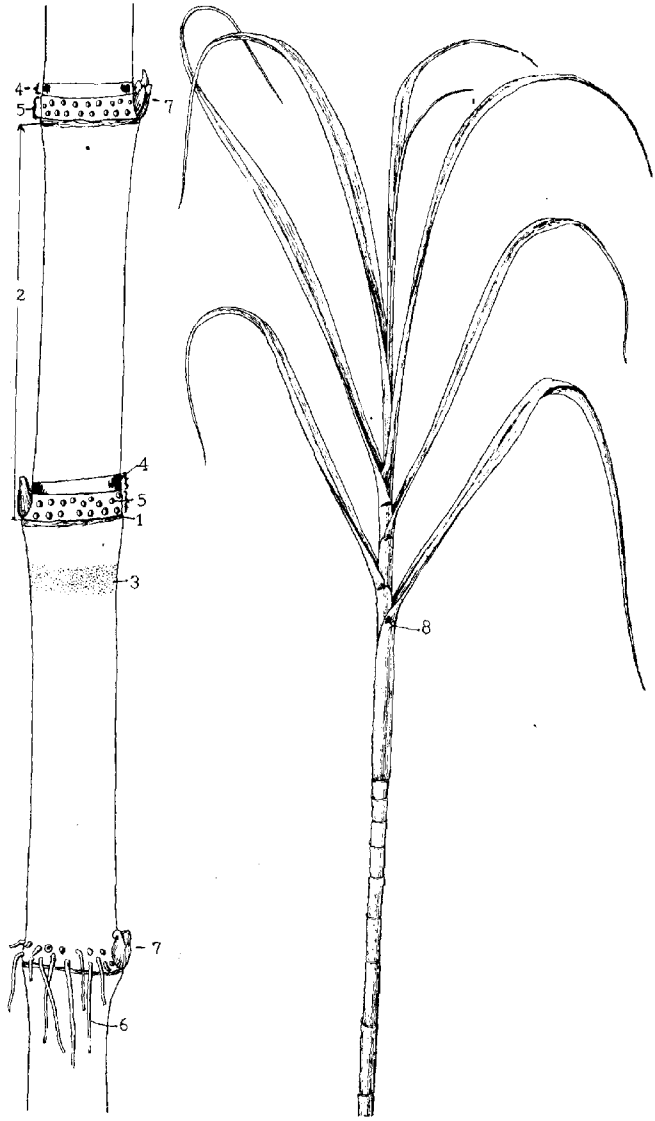
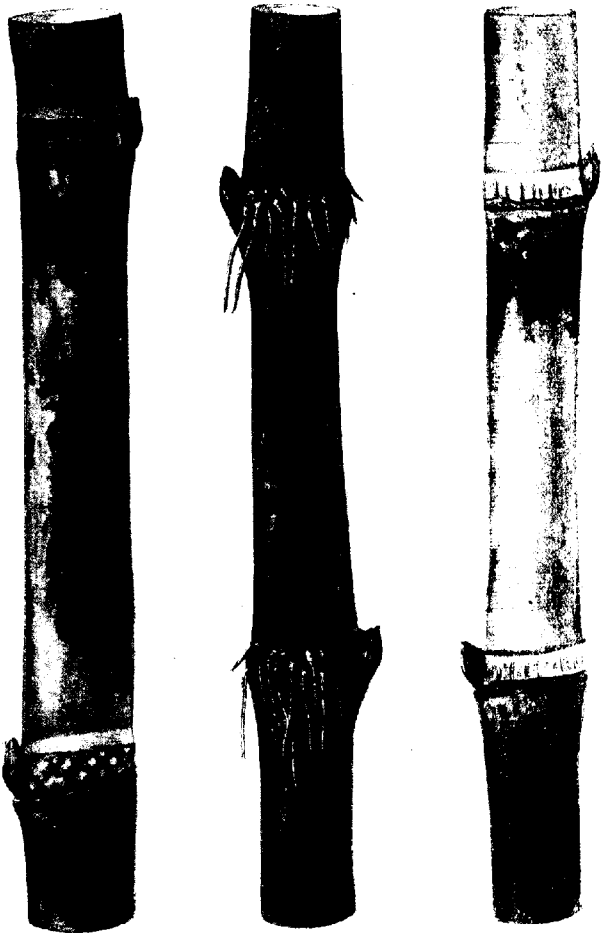


1. Node.
2. Internode.
3. Wax band.
4. Colour band.
5. Rooting band.
6. Aerial roots.
7. Dormant buds.
8. Ligular band.

TO ILLUSTRATE NOMENCLATURE USED IN THIS PAPER.

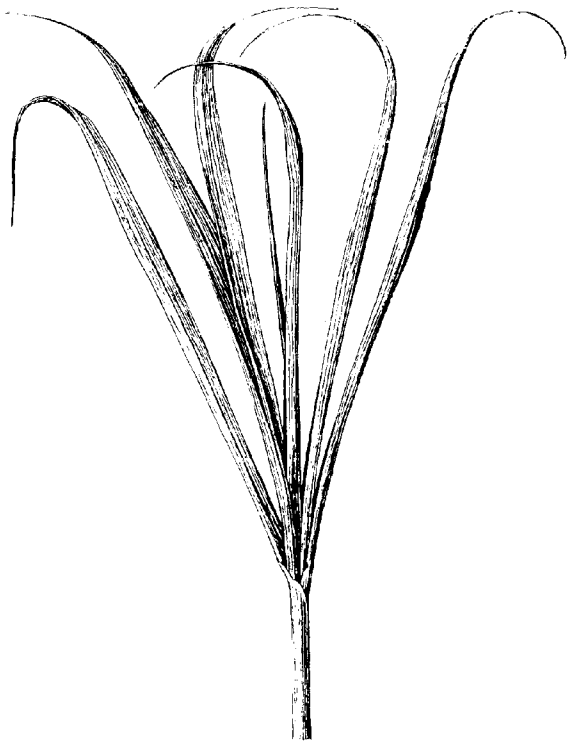
PLATE II.



III.
MANERIA

II.
BARAUKHA

I.
BANSA



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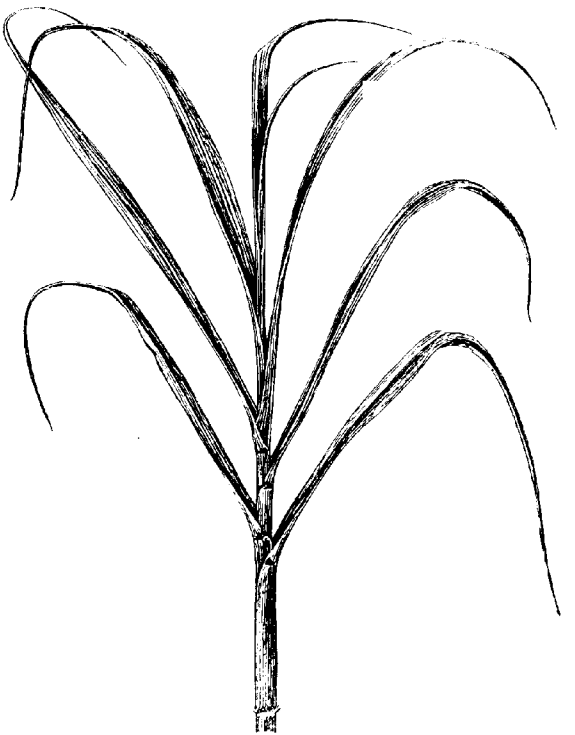

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